

**DEPARTMENT OF TRANSPORTATION**  
**ENGINEERING SERVICE CENTER**  
Transportation Laboratory  
P. O. Box 19128  
Sacramento, California 95819



## METHOD OF TEST FOR RELATIVE MORTAR STRENGTH OF PORTLAND CEMENT CONCRETE SAND

**CAUTION:** Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read “**SAFETY AND HEALTH**” in Section K of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

### A. SCOPE

This test is for the purpose of determining the compressive strength developed by mortar using a given concrete sand, in relation to that developed by mortar using Ottawa sand, and indirectly measures the concrete-making properties of the sand being tested.

### B. APPARATUS

The molds, tools, and apparatus used shall be as described in ASTM Designation: C 109,

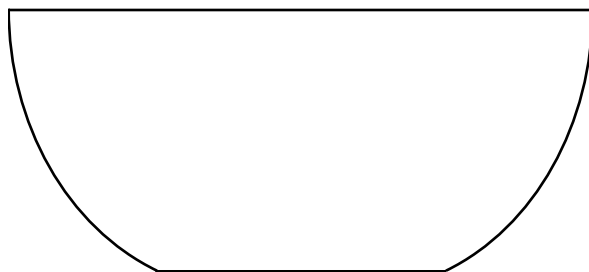


FIGURE 1 - MIXING BOWL

with the exception that the mixing of the mortars shall be done manually in a stainless steel mixing bowl having a nominal capacity of 5.5 to 8 L. The shape of the bowl shall conform to Figure 1 and shall have inside dimensions such that the ratio of the diameter at the top to the diameter at the bottom shall not be less than 1.8, and the ratio of the diameter at the top to the depth shall be  $2.2 \pm 0.2$ .

The sieves shall be standard 203-mm diameter, full-height, wire-cloth sieves, conforming to the requirements of ASTM Designation: E 11, and of the following sizes: 4.75-mm, 2.36-mm, 1.18-mm, 850- $\mu$ m, 600- $\mu$ m, 425- $\mu$ m, 300- $\mu$ m and 150- $\mu$ m.

### C. MATERIALS

1. Portland cement, Type II;
2. Standard Sand conforming to ASTM Designation: C 778 for 20-30 sand;
3. Graded Ottawa sand conforming to Section 4 of ASTM Designation: C 778.

#### D. TEST RECORD FORM

Record test data on Form TL-0550.

#### E. CONTROL

Three batches of control cubes shall be fabricated on different days in accordance with the following procedure:

1. The control mix shall consist of the following:
  - a. 400 g of portland cement.
  - b. 400 g of 20-30 Standard Sand.
  - c. 400 g of Graded Ottawa Sand.
  - d. Water sufficient to produce a flow between 75 and 85, as determined according to paragraph 3 of this section.
2. The mortar shall be mixed in the bowl by vigorous and continuous stirring, squeezing, and kneading with one hand which shall be protected by a snug-fitting rubber glove. The materials for a batch shall be introduced in the following manner:
  - a. Place the water in the bowl, which has just been wiped with a damp cloth or damp sponge;
  - b. Add the cement to the water and mix for  $30 \pm 3$  s;
  - c. Add approximately one half of the sand and mix for  $30 \pm 3$  s;
  - d. Add the remainder of the sand and mix for  $90 \pm 3$  s.
3. When mixing has been completed, a flow test shall be made according to Section 10.3 of ASTM Designation: C 109, except that the table shall be dropped 10 times in 6s. If the mortar has a flow greater than 85, discard the batch. If the flow is less than 75, return the mortar to

the mixing bowl and add more water. In making a second flow test, add 4 to the observed flow to correct for additional handling.

4. When a flow between 75 and 85 has been obtained, the mortar shall be placed in the 50 by 50 by 50-mm molds and stored in accordance with the method described in ASTM Designation: C 109. Since the mortar as described is of a stiffer consistency than that used in cement testing, particular attention shall be given to make sure that the mortar is thoroughly consolidated in the molds.
5. Three cubes from each batch shall be tested for compressive strength at 7 days.

#### F. PREPARATION OF CONCRETE SAND TEST SAMPLE

1. Unless the fine aggregate has been washed during manufacture or is intended for use without washing, it shall be washed to produce a material meeting the requirements of the Standard Specifications for cleanliness and to a degree commensurate with good commercial practice.
2. After washing, the aggregate shall be oven dried at a temperature not exceeding  $110^{\circ}\text{C}$  and separated on sieves 4.75 mm to  $600\text{ }\mu\text{m}$ , inclusive, and recombined to give the following grading:

Passing 4.75 mm	100 %
Passing 2.36 mm	78 %
Passing 1.18 mm	59 %
Passing $600\text{ }\mu\text{m}$	35 %

3. Fine sands intended for blending with coarse sands shall be combined with the proposed coarse sand before preparing the sample in the grading set forth above.
4. A quartered fraction of the washed and regraded material shall be tested for bulk specific gravity (saturated, surface-dry basis) and percentage of absorption in accordance with California Test 207.

## G. MIXING AND FABRICATION

1. The test mix for the concrete sand mortar shall consist of the following:
  - a. 400 g cement.
  - b.  $(300 \times G)$  grams concrete sand (saturated, surface-dry), where  $G$  = bulk specific gravity (saturated, surface-dry).

Since the concrete sand has been previously oven dried, the weight of the sample shall be adjusted to the saturated surface-dry condition by adding the calculated amount of water to the dry sand.

Example: A concrete sand when washed, dried, and regraded, has a saturated surface-dry specific gravity of 2.72 and an absorption of 1.8 percent. The quantity of the saturated, surface-dry material to be used is:

$$300 \times 2.72 = 816 \text{ g}$$

The weight of the dry sand to be used is:

$$816 / 1.018 = 802 \text{ g}$$

The water to be added to adjust the weight of sand to the saturated surface-dry condition is:

$$816 - 802 = 14 \text{ g}$$

- c. Water, measured in milliliters, sufficient to produce a flow between 75 and 85, as determined in accordance with Section 10.3 of ASTM Designation: C 109, except that the table shall be dropped 10 times in 6 s.
2. Place the dry concrete sand in a pan, add amount of water required to reach saturated, surface-dry condition, mix thoroughly with a spatula, cover with a

damp cloth, and allow to stand 15 to 30 min before adding portland cement. A plastic container with tight sealing cover may be used.

3. The test batch shall be mixed and placed in 50 by 50 by 50-mm molds in the same manner as that described for the control batch. See Section E, Control.
4. Three cubes from each batch shall be fabricated and tested for compressive strength at 7 days. Storage of the specimens shall be as specified in ASTM Designation: C 109.

## H. TEST AND CALCULATIONS

Relative mortar strength is the ratio of the strength of the test sand mortar to the strength of the Ottawa sand mortar (control), times 100.

The strength of the test sand mortar should be the average strength of 3 cubes from a single batch.

The strength of the Ottawa sand mortar (control) shall be the average strength of 3 batches of material (3 cubes per batch), fabricated on different days. The control strength so established, can be used as the control for all sands tested within the limits as specified below.

All batches (test sand and Ottawa sand mortars) used to determine the relative strength, shall be made within a 30-day period.

If the calculated percentage is not exactly divisible by 5, the value shall be raised to the next higher multiple of 5. Thus 102 % becomes 105 %, and 106 % becomes 110 %. This adjusted value shall be known as the "Relative Mortar Strength."

The compressive strength tests shall be made on a testing machine conforming to the requirements of ASTM Designation: C 109.

**I. NOTES**

Since difficulty is sometimes experienced in obtaining the proper flow on the sand to be tested, two test samples are usually prepared for each test to save time.

**J. REPORTING OF RESULTS**

Report results of this test on Form TL-0200.

**K. SAFETY AND HEALTH**

Prior to handling, testing or disposing of any waste materials, testers are required to

read: Part A (Section 5.0), Part B (Sections: 5.0, 6.0 and 10.0) and Part C (Section 1.0) of Caltrans Laboratory Safety Manual. Users of this method do so at their own risk.

**REFERENCES:**

**ASTM Designations: C 109,  
C 128 and C 778  
California Test 207**

**End of Text (California Test 515 contains 4 pages)**